Synthesis of polymer from natural resources, its characterization and application as an emulsifying agent

Synopsis submitted to IIMT UNIVERSITY in partial fulfillment of the requirements for the award of the Degree of

DOCTOR OF PHILOSOPHY

IN

CHEMISTRY

BY

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DECLARATION

The research work embodied in this synopsis entitle "**Synthesis of Polymer from Natural Resources, its characterization and application as an Emulsifying Agent"** will be carried out in the laboratory of Department of chemistry, School of Basic Sciences & Technology, IIMT University, Meerut. The work is original and has not been submitted in part or full for any degree or diploma of this or any other university.

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1.Introduction

Chemical, physical, and/or biological processes are utilised in the production of bio-based polymeric materials [1,2]. These materials are derived from renewable resources. In the production of bio-based polymers, the primary raw materials that are utilised are feedstocks derived from agriculture and forestry [3, 4], [5], [6], [7]. These feedstocks include maize fibre, wheat by-products, waste from food processing, sludge from paper mills, waste from forests, and other similar materials. The abundant and long-lasting resources have provided bio-based polymers with a substantial advantage, like non-toxicity, non-biodegradable and eco-friendly nature of these materials [8, 9], [10], [11], [12]. As a result, the significance of natural polymers is generally acknowledged, and a significant increase in the number of research endeavours that are concentrated on this area has been observed. In the past few years, there has been a consistent rise in the number of articles that pertain to bio-based polymers, as seen in Figure 1 of the Web of Science database.

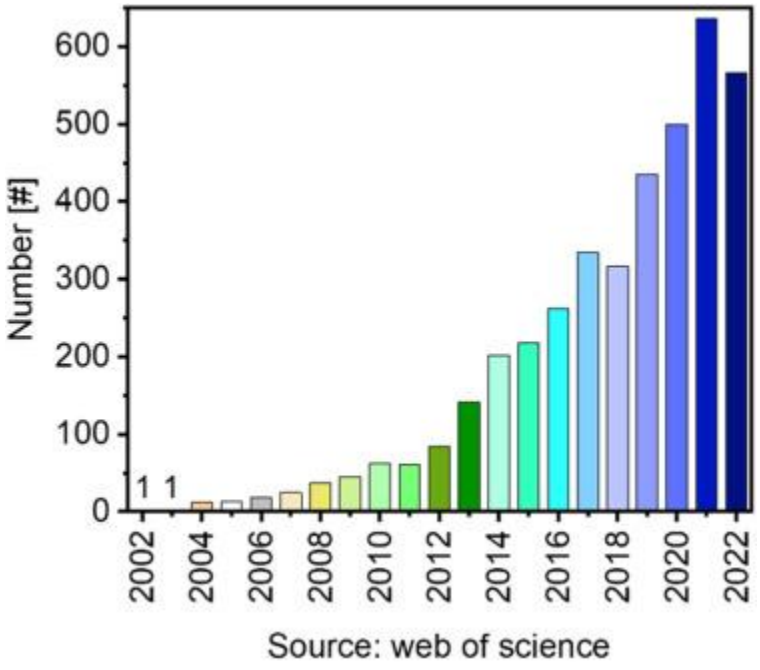


Fig. 1. Details of number of publication of bio-based polymers in recent years (License: creative common license)

It has been estimated that the total production volume of bio-based polymers is approximately 4.2 million tonnes at the present time, which accounts for one percent of the total production volume of fossil-based polymers [13]. This is due to the fact that economic, political, and international issues are all having an effect on the production volume now. In addition, the compound annual growth rate (CAGR) was over 8%, which was considerably larger than the general growth of polymers, which was between 3 and 4%. It should come as no surprise that the bio-based polymer sector experienced consistent growth. Both the recent significant advancements in the quality and functionality of bio-based polymers and the great social interest in preserving a sustainable society have synergistically contributed to the expansion. To summarise, there are two common methods for creating bio-based polymers: (1) using renewable resources and their derivatives as starting materials to create bio-based polymers, like rosin-based polymers [16] and ethyl cellulose [14,15]; or (2) using fermentation and chemical conversion processes to create bio-based monomers or platform chemicals, which are then used to create polylactic acid (PLA) [17,18], bio-polyethylene (PE), and polybutylene succinate (PBS). Furthermore, the metabolic processes of bacteria may directly synthesise bio-based polymers, including polyhydroxyalkanoates and bacterial cellulose [19]. Although it exhibits a limited degree of flexibility, the first production method offers greater production efficiency and preserves the underlying structural components to the fullest extent possible. The second strategy allows monomers to have a wide range of chemical configurations, and the main way that this approach contributes to the environmental impact is by reducing the carbon footprint.

The synthesis, characteristics, and uses of bio-based polymers made from natural triglycerides will be the primary topics of this article. It discusses the synthesis processes and characteristics of bio-based thermoplastics and thermosets, the creation of bio-based composites and functional polymers, and the fundamental structures and characteristics of bio-based monomers.

2.Literature Gap

S. No	Studies Conducted	Findings	Source
1	HA & lignin based hydrogels	Multifaceted potential of HA & lignin based hydrogels.	[21]
2	Synthesis of lanthanum Anionic resin	Electrostatic & ligand combinations	[22]
3	Cellulose based polymeric materials	Adsorption of heavy metals	[23]
4	Review of different methods for synthesis of cellulose based as fertilizers	Decontamination of soil	[24]
5	Wheat straw based hydrogels	New soil amendments	[25]
6	Progress in lignin based hydrogels	Removal of toxic chemicals	[26]
7	Synthesis of PVA hydrogels.	Plant growth promoted	[27]

3. **What are Natural Polymers?**

Certain types of plant and animal biomass have polymer molecular units that are repeated and ordered in a certain pattern. They exhibit characteristics of polymeric materials derived from fossils and are referred to as natural polymers. The natural polymers that were extracted from various biomass resources are categorised according to the resources that were utilised in the extraction process. In animals and plants, they can be found in the form of protein macromolecules, which are composed of amino acids that are linked together by peptides; polysaccharide macromolecules, which are composed of monosaccharides that are linked together by glycosidic bonds; or lipid–long chain hydrocarbon molecules that contain a carboxylic acid component.According to their origin, the classification of Natural polymers is shown in Figure 2.

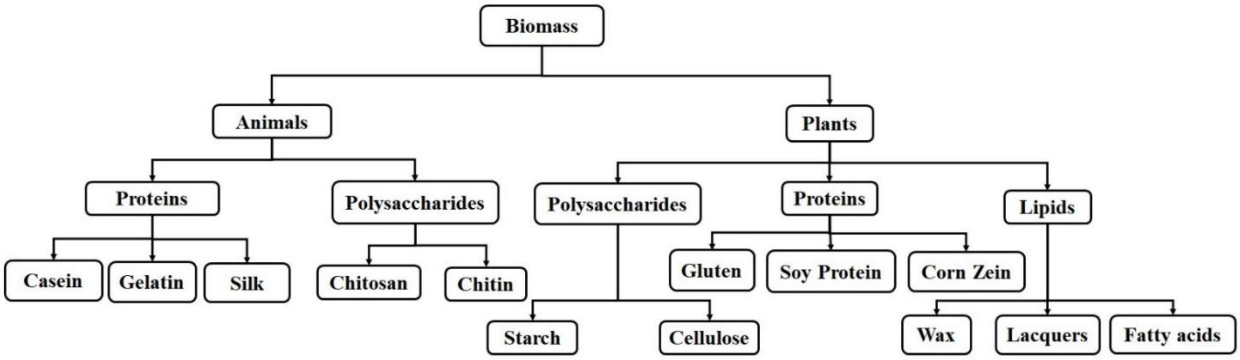


Figure 2: Types of natural polymers extracted from renewable resources (https://doi.org/10.3390/polym14194033) (License Open Access)

4 .Objectives of The Present Work

The main objective of this research is development of low cost, environmental friendly anionic polymeric surfactant from naturally available triglycerides and their properties evaluation for its application as an emulsifying agents. The scope of the study comprises of:

1. Selection of required chemicals for the synthesis of Polymer.
2. Structural and physicochemical characterization of the synthesized polymer by FTIR, GC, DLS, TGA, FESEM and EDX analysis.
3. Investigation on surface and interfacial behavior of the polymer in its aqueous solution.
4. Physiochemical and rheological properties evaluation of synthesized polymeric material
5. Investigation on emulsifying properties of the polymer in its aqueous solution.

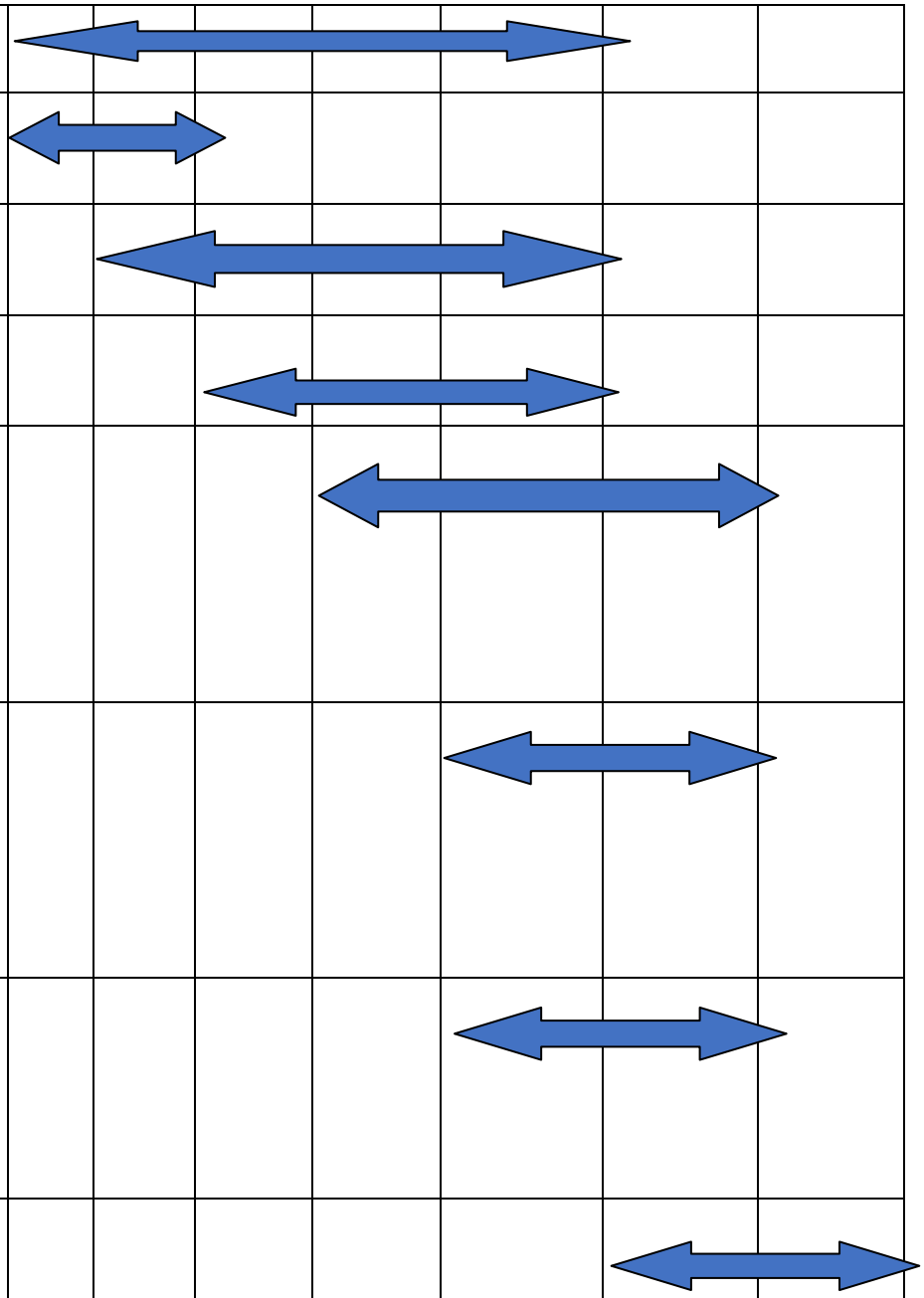
Plan of Work:

The month wise plan of work is shown in the Time-Table given below.

Time-table or milestones

Activities	**Duration in months**						
	0-3	3-6	7-12	13-18	19-24	25-30	31-36

Literature review	
Identification of source.	
Synthesis of the Polymer	
Characterization of the Polymer	
Investigation on surface and interfacial behavior of the polymer in its aqueous solution.	
Physiochemical and rheological properties evaluation of synthesized polymeric material	
Investigation on emulsifying properties of the polymer in its aqueous solution.	
Data compilation, comparison and paper writing	



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